In and around Orion

Study time: 90 minutes

Summary

In this observational activity you will perform and record some simple observations of various celestial objects in and near the prominent constellation, Orion.

You should study the *Observational activities* booklet and view the video sequence 'Preparing for observing' before undertaking this activity. You should do this activity before 'Limiting visual stellar magnitudes', although both of these activities can be done during the same observing session.

The study time indicates how long you will need for the observing session(s) and includes preparation and note taking; the observations themselves should take less time. Data analysis and writing up require additional time after the observing session.

Learning outcomes

The learning outcomes for the observational activities are grouped together at the front of the *Observational activities* booklet.

Preparation

The greater the altitude above the horizon of a celestial object, the less are the effects of atmospheric extinction (the reduction in the light reaching you from a celestial body, as a result of absorption and scattering in the atmosphere). The effects of light pollution also diminish with increasing altitude (light pollution is light, usually from ground level, scattered downwards by small liquid and solid particles in the atmosphere). Therefore, try to make your observations when Orion is close to its maximum altitude, i.e. within a couple of hours or so of crossing/having crossed your meridian: use your planisphere to plan your observing time.

Also, avoid making observations when the Moon is between first and third quarters, or in the same general direction as Orion. Moonlight increases the level of light pollution.

When you go to your observing site to do this activity, you will need to take:

- the planisphere and, if not identified already, a means of identifying north (such as a magnetic compass)
- these activity notes
- a torch (flashlight)
- a clear plastic 30 cm ruler, marked in millimetres
- your activity notebook plus something to write with.

Though a useful fraction of this activity can be completed without binoculars, if you have access to binoculars then do take them with you.

Observations

1 Your first task is to find Orion. On the planisphere it is centred on the celestial coordinates (5 h, 0°). On site, identify the northerly direction, and use the planisphere to identify roughly where you should look to see Orion. You might spot Orion at once, particularly if you have any experience at constellation spotting. Less experienced observers should find Figure 1 of help. If you hold it

at arm's length in front of you (about 600 mm from your eye) then this is the pattern that the main stars in Orion form, at about the correct angular separations.

2 Measure the angular separation (in degrees) between Betelgeuse ('betel-jers') and Rigel ('rye-jel'), the two most prominent stars in Orion (Figure 1). One way of doing this is to hold a clear plastic ruler at arm's length against the sky, using the torch (perhaps dimmed) to illuminate the scale. This method is outlined in Figure 2 (*overleaf*). If the ruler is a distance d from the front of your eye (Figure 2), then the angle α between two objects separated by h on the ruler is given by

$$\alpha/\text{radians} \approx h/d$$

or

$$\alpha/\text{deg} \approx 57 \times (h/d) \qquad (1)$$

This approximation is sufficiently good for this activity, up to $\alpha \approx 20$ deg. (It gets worse as α increases, because the ruler is not following the circle centred on your eye – shown as the curved line in Figure 2.) In your activity notebook, outline your method and record your values of h, d and α.

You must now calculate the *uncertainty* $\Delta\alpha$ in α. This depends on your estimates of the uncertainties Δh and Δd in h and d.

First, calculate $\alpha_{\text{max}}/\text{degree} \approx 57 \times (h + \Delta h)/(d - \Delta d)$

then calculate $\alpha_{\text{min}}/\text{degree} \approx 57 \times (h - \Delta h)/(d + \Delta d)$

We then have the uncertainty in α:

$$\Delta\alpha/\text{degree} \approx (\alpha_{\text{max}} - \alpha_{\text{min}})/2 \qquad (2)$$

This rough and ready method will do for our purposes. Record the details of your calculations in your activity notebook.

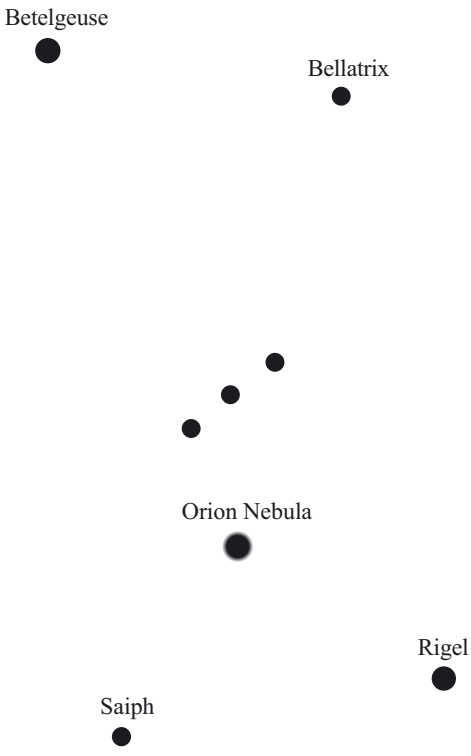

Figure 1 The main stars in Orion.

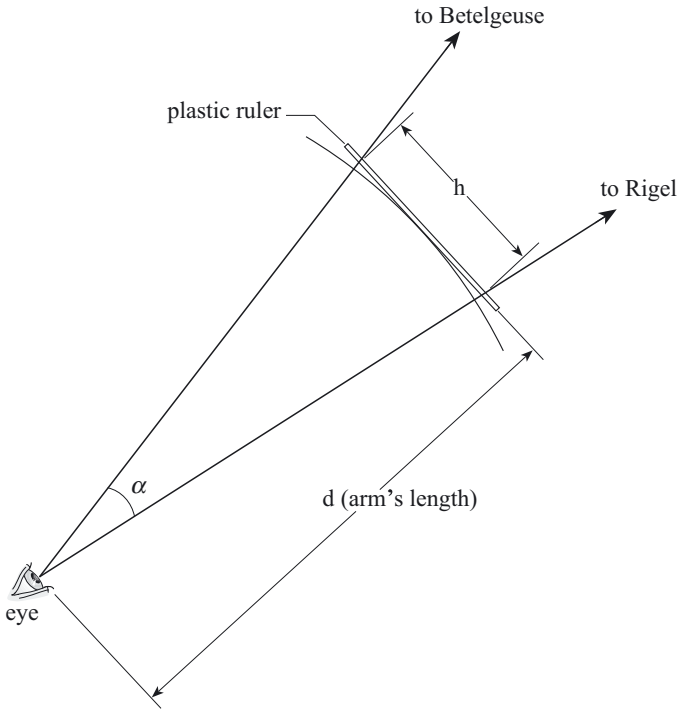

Figure 2 Obtaining angular separation.

3 Compare the colours of the stars Betelgeuse and Rigel with the unaided eye. If you have binoculars, then try defocusing them very slightly – this might help to show the colour difference. Record your observations and state whether they are in accord with the surface temperatures of these stars given in Table 1. (Note that Rigel is a double star, but we only really see the brighter, Rigel A. You will meet Rigel and Betelgeuse again in Chapter 3 of *An Introduction to the Sun and Stars*.)

Table 1

Star	**Luminosity/$L_\odot$**	**Temperature/K**
Betelgeuse	100 000	3500
Rigel	140 000	13 000

4 If the sky is dark and clear, then, with the unaided eye, try to spot the Orion Nebula (Figure 1) – part of a massive dense cloud, lit by the very young stars born in the cloud less than a million years ago. To the unaided eye it looks like a faint star, but binoculars reveal a small, fuzzy patch – not as glorious as Figure 4.13 in *An Introduction to the Sun and Stars*, but distinctly non-stellar! Even if the sky is so bright that the Orion Nebula is invisible to the unaided eye, it may still be visible with binoculars. Describe briefly what you can see with the unaided eye and binoculars; include a sketch if this is helpful.

The following observations are of particular interest if you have access to a pair of binoculars. If not, you may still wish to observe using the naked eye.

5 With the aid of a planisphere, find the star cluster known as the Pleiades (‘ply-a-dees’), which is centred on (3.7 h, +24°). With the unaided eye this cluster might appear only as a fuzzy patch, although in a dark sky up to seven stars (the Seven Sisters) might be discernable. With binoculars, many tens of stars will be seen. The Pleiades is an open cluster, and contains several hundred stars, all fairly young. Describe briefly what you see, with and without binoculars. Hence write down the improvements that your binoculars bring to your view of the Pleiades.

6 Finally, if the sky is dark and moonless, then even with the unaided eye you should be able to see the Milky Way, between Orion and the north celestial pole (see the planisphere). The Milky Way is a broad band of light that is our edgewise view through the Galaxy. With binoculars the band will be resolved into myriads of stars. Follow the Milky Way with your binoculars until you reach the region of the constellation Perseus around (3 h, +50°). This is a particularly rich area. Describe briefly what you see, with and without binoculars. Have your binoculars brought about the same improvements as when you used them to view the Pleiades?